pH and pOH Calculations Practice #1

***Part 1**: Fill in the missing information in the table below.*

pH	[H_3O^{1+}]	pOH	[OH^{1-}]	ACID or BASE?
3.78	1.66×10^{-4} M	10.22	6.03×10^{-11} M	Acid
3.41	3.89×10^{-4} M	10.59	2.57×10^{-11} M	Acid
		5.19		
	2.04×10^{-9} M	5.31	4.88×10^{-6} M	Base
8.46			2.88×10^{-6} M	Base
	8.45×10^{-13} M			
11.86	1.38×10^{-12} M	2.14	7.24×10^{-3} M	Base
			2.31×10^{-11} M	
10.91	1.23×10^{-11} M			Base
	7.49×10^{-6} M	8.87	1.35×10^{-9} M	
4.06	8.71×10^{-5} M	9.94		Acid
			2.57×10^{-8} M	
4.16	6.92×10^{-5} M	9.84	1.45×10^{-10} M	Acid
0.98	1.06×10^{-1} M	13.0		
10.18		3.82	1.51×10^{-4} M	Base
	1.17×10^{-8} M		8.53×10^{-7} M	

***Part 2**:*

1. A. Write the equation for the dissociation of hydrochloric acid.

$$HCl(aq) \rightarrow H^{1+}(aq) + Cl^{1-}(aq)$$

B. Find the pH of a 0.00476 M hydrochloric acid solution.

$$\underset{0.00476\ M}{HCl(aq)} \rightarrow \underset{0.00476\ M}{H^{1+}(aq)} + Cl^{1-}(aq)$$

pH= 2.32

2. A. Write the equation for the dissociation of sulfuric acid.

$$H_2SO_4(aq) \rightarrow 2\ H^{1+}(aq) + SO_4^{2-}(aq)$$

B. Find the pH of a solution that contains 3.25 g of H_2SO_4 dissolved in 2.75 liters of solution.

$$\text{Step 1: } x\,\text{mol}\,H_2SO_4 = 3.25\,\text{g}\,H_2SO_4\left(\frac{1\,\text{mol}\,H_2SO_4}{98\,\text{g}\,H_2SO_4}\right) = 0.033\,\text{mol}\,H_2SO_4$$

$$\text{Step 2: } M = \frac{\text{mol}}{\text{L}} \Rightarrow M = \frac{0.033\,\text{mol}\,H_2SO_4}{2.75\,\text{L}} \Rightarrow M = 0.0121\,\text{M}\,H_2SO_4$$

$$\text{Step 3: } H_2SO_4(aq) \rightarrow 2H^+ + SO_4^{2-}(aq)$$
$$0.0121\,\text{M} \qquad \therefore 0.0242\,\text{M}$$

$$\text{Step 4: } pH = -\log[H^+] \Rightarrow pH = -\log[0.0242\,\text{M}] \Rightarrow pH = 1.62$$

3. A. Write the equation for the dissociation of sodium hydroxide.

$$\underset{0.000841\ \text{M}}{\mathbf{NaOH}(aq)} \rightarrow \mathbf{Na^{1+}}(aq) + \underset{0.000841\ \text{M}}{\mathbf{OH^{1-}}(aq)}$$

B. Find the pH of a 0.000841 M solution of sodium hydroxide.

$$pOH = -\log[OH^-]$$
$$pOH = -\log[0.000841\,\text{M}]$$
$$pOH = 3.08$$

$$pH + pOH = 14$$
$$pH + 3.08 = 14$$
$$pH = 10.92$$

Or

$$K_w = [H^+][OH^-]$$
$$1\times10^{-14} = [H^+][0.000841\,\text{M}]$$
$$[H^+] = [1.19\times10^{-11}\,\text{M}]$$

$$pH = -\log[H^+]$$
$$pH = -\log[1.19\times10^{-11}\,\text{M}]$$
$$pH = 10.92$$

4. A. Write the equation for the dissociation of aluminum hydroxide.

$$\underset{2.36\text{x}10^{-5}\ \text{M}}{\mathbf{Al(OH)_3}(aq)} \rightarrow \mathbf{Al^{3+}}(aq) + \underset{7.08\text{x}10^{-5}\ \text{M}}{\mathbf{3\ OH^{1-}}(aq)}$$

B. If the pH is 9.85, what is the concentration of the aluminum hydroxide solution?

$$pH + pOH = 14$$
$$9.85 + pOH = 14$$
$$pOH = 4.15$$

$$pOH = -\log[OH^-]$$
$$4.15 = -\log[OH^-]$$
$$[OH^-] = 7.08\times10^{-5}\,\text{M}$$

$$\frac{7.08\times10^{-5}mol\,OH^{-1}}{1L} \times \frac{1molAl(OH)_3}{3molOH^{-1}} = 2.36\times10^{-5}M$$

5. A. Write the equation for the dissociation of calcium hydroxide.

$$\underset{2.18\text{x}10^{-3}\ \text{M}}{\mathbf{Ca(OH)_2}(aq)} \rightarrow \mathbf{Ca^{2+}}(aq) + \underset{4.37\text{x}10^{-5}\ \text{M}}{\mathbf{2\ OH^{1-}}(aq)}$$

B. If the pH is 11.64 and you have 2.55 L of solution, how many grams of calcium hydroxide are in the solution?

$$pH + pOH = 14$$
$$11.64 + pOH = 14$$
$$pOH = 2.36$$

$$pOH = -\log[OH^-]$$
$$2.36 = -\log[OH^-]$$
$$[OH^-] = 4.37\times10^{-3}\,\text{M}$$

$$2\overline{)4.37\times10^{-3}\,\text{M}} \quad 2.18\times10^{-3}\,\text{M}$$

$$M = \frac{\text{mol}}{\text{L}} \Rightarrow 2.18\times10^{-3}\,\text{M} \Rightarrow \frac{x\,\text{mol}\,Ca(OH)_2}{2.55\,\text{L}} \Rightarrow x = 5.57\times10^{-3}\,\text{mol}\,Ca(OH)_2$$

$$x\,\text{g}\,Ca(OH)_2 = 5.57\times10^{-3}\,\text{mol}\left(\frac{74\,\text{g}\,Ca(OH)_2}{1\,\text{mol}\,Ca(OH)_2}\right) = 0.412\,\text{g}\,Ca(OH)_2$$